Thermal imaging cameras: a cost effective solution for perimeter protection

FLIR PTZ-50 MS

Today, the challenge to CCTV professionals is to make sure that video footage is effective on a 24/7 basis, 365 days a year. Securing an area during the daytime is one thing. But what happens during the night? And in weather conditions like fog, rain and snow? What can be detected if CCTV cameras are blinded by the sun?

As CCTV systems become more advanced the security industry will move to raise the standard for all CCTV installations to be designed for 24 hour surveillance, not just day-time operation. To be truly secure, a site must be protected day and night.

A number of tools are available to help detect potential intruders in the dark. Often different technologies are being combined to create a secure perimeter. Fences can be complemented with Closed-Circuit Television (CCTV) systems with or without active infrared illumination or old fashioned light bulbs, Radio Frequency Intruder Detection (RAFID) systems, thermal imaging cameras and/or walking patrols.

Whatever solution or technology is chosen for securing an area, they all have their advantages and disadvantages and some technologies are more expensive than others. To get a full picture of the Total Cost of Ownership (TCO) for a certain solution, not only the initial installation cost but also the maintenance cost needs to be taken into account. Some solutions consume a lot of power and need a lot of spare parts. Environmental and energy consumption issues are today high on the global agenda. Given that $1 from every $5 spend globally is used on lighting, and much of this is spend on inefficient and unnecessary lighting particular attention should be given to this area. The focus to save energy by looking at running costs will continue to increase. Local authorities and private industries are all looking at methods to save energy costs and lighting is one area due careful attention.

Quite a number of technologies are available to help detect potential intruders in the dark before they become a real hazard. Let´s compare some of them:
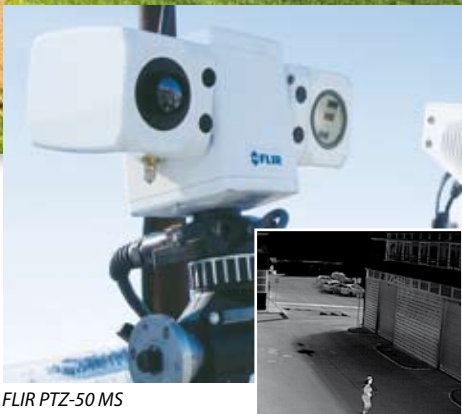
FLIR PTZ-35x140 MS

FLIR SR-series

Surveillance at night

Closed-circuit television (CCTV) combined with traditional lighting

CCTV systems have been an effective tool for security and surveillance applications. However, just like the human eye, CCTV cameras do not see too much in total darkness. So in order to detect intruders at night they are often complemented with traditional lights by mains driven bulbs. Although some bulbs (fluorescent lamps, HID lamps) are more efficient than others the operational cost is very high. Light can only penetrate a certain distance and completely illuminating an area, so that it can be kept under surveillance of CCTV cameras, is not always possible. Powering and maintaining the lights can even be more costly.

CCTVs with traditional lamp lighting require lamp replacement every 2000 to 4000 hours or about every 8 months. There is significant labour and material cost associated with lamp replacement.

Light pollution is a global problem caused by inefficient, intrusive and unnecessary use of artificial light. Symptoms include glare, clutter overillumination and sky glow. Light pollution is an increasingly hot political topic given recent government legislation to control and punish light pollution. In some locations light is also considered to be too intrusive.

Furthermore, lighting essentially lays out a route of attack for intruders, creating shadows in which they can hide and access undetected.

Closed-circuit television (CCTV) combined with LED's

Compared to any bulb, LED's provide significant savings on electrical consumption. LED's also provide long life performance with little ongoing maintenance costs.

Infrared illumination with LED's, sometime also called active infrared, beams infrared radiation into the area in front of a camera. The LED's are often placed around the lens of the camera.

LED illumination is compromised by limited range performance. Also, providing lighting for domes has long been a challenge for CCTV professionals as the lighting cannot be fitted to move with the camera.
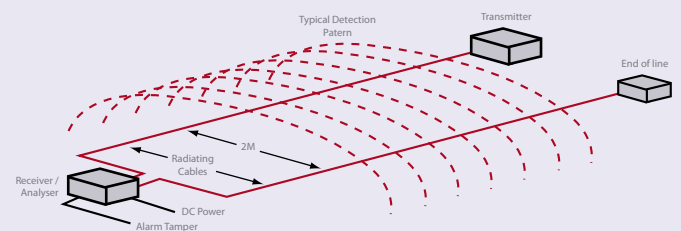
Electrified fences

In order to keep intruders out of certain areas fences can be constructed. To further increase security, fences can be equipped with sensors that generate an automatic alarm when someone touches the fence. Or they can be electrified, to keep intruders away.

In all cases, fences need to be complemented by other technologies such as CCTV cameras or walking patrols in order to see what is happening around the fence.

Radio Frequency Intruder detection (RAFID)

The simplest description of RAFID is to consider a system using two specially designed cables – one transmitting a radio wave, while the other receives that wave.

Typical Detection Patern
Transmitter
End of line
2M
Radiating Cables
Receiver / Analyser
DC Power
Alarm Tamper

Changes in the amount of signal passing between the transmitter cable and receiver cable are analyzed by a signal processor. If the amount of signal changes, this means that someone or something is between the two cables and an alarm will go off. Due to the difference in the signal strength, the system can detect whether these changes are due to the presence of a human, a small animal, …

Note that in a lot of cases CCTV cameras still need to be installed in order to see what is generating a real, or false, alarm.

Thermal imaging

A new tool for seeing in total darkness, in the most diverse weather conditions is thermal imaging. Thermal imaging is the use of a thermal imaging camera to "see" thermal energy emitted from an object. Thermal imaging cameras produce images of invisible infrared or "heat" radiation. Based on temperature differences between objects, thermal imaging produces a crisp image on which the smallest of details can be seen. They work both during daytime and nighttime.

Most FLIR Systems thermal imaging cameras contain an uncooled Vanadium Oxide detector. Not only produces it excellent quality thermal images, since it is not containing any moving parts, it needs no maintenance. Thermal imaging technology requires no additional lighting or illumination and has no regular maintenance costs.

FLIR PTZ-50 MS

FLIR SR-100
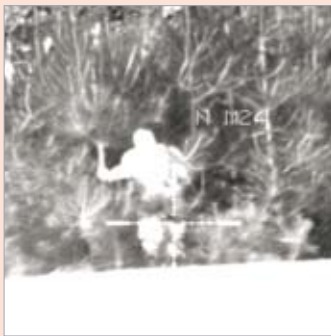
Deciding which technology to use

Security managers are more familiar with certain technologies than with others. Before making a final decision about which technology will be implemented to secure a perimeter at night, it is a good idea to have a look at the advantages and disadvantages of each technology.

This table tries to summarize the different technologies and their advantages / disadvantages.

	Advantages	Disadvantages
CCTV with traditional lighting or LED	- Good visibility during daytime - Relatively low initial cost	- A lot of cameras need to be installed to cover a large perimeter - Limited detection at night. Light illuminates only certain small area. - Limited capabilities in fog, rain, … - Civil works need to be carried out to install light poles - High power consumption - High maintenance cost for replacing the lights: material and manpower
Electrified Fence	- Creates a physical barrier - Allows to stop intruders - Works during the night as well	- High installation cost - Full civil works needed - Power consumption - Needs to be complemented with CCTV to see if alarm is falls or not. Light or infrared illumination needed during the night to do this.
RAFID or Sensor Cable	- Fully automated system - Works in total darkness	- High installation cost - Full civil works needed - Troubleshooting and maintenance after installation - Many falls alarms - Needs to be complemented with CCTV to see if alarm is falls or not. Light or infrared illumination needed during the night to do this.

Thermal imaging	- Full awareness
	- Can be used day and night
	- Works in practically all weather conditions.
	  Can see through light fog, rain, smoke, ...
	- No downtime, low maintenance
	- Low power consumption
	- Extremely difficult to hide from since thermal contrast
	  in practically impossible to mask
		- No physical barrier
		- Potential intruders are easily spotted but not identified

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Case study

Comparing technologies and looking at the benefits each one has to offer is only a first step. Although it already gives a good idea about every technology, the real cost needs to be calculated in order to make a final decision.

Not only the initial purchase of the system needs to be considered, the Total Cost of Ownership needs to be calculated. For example, many people do not take into account the electricity consumption of an installation when deciding which technology to install.

One way to compare the Total Cost of Ownership for different solutions is by taking an example 1km x 1km perimeter around an industrial facility and comparing the costs of different solutions.

Assumptions:
- *A perimeter of 1 km x 1km x 1km x 1km needs to be protected*
- *The perimeter needs to be secured day AND night, in all weather conditions. This means that CCTV cameras need to be complemented with other technologies as light, infrared illuminators, …*

1 km · 1 km · 250 m · Electrified Fence

Perimeter (meters)		4,000		
Expected Life of System		5 Years		
	Thermal Fence	CCTV and IR Lighting	RAFID (Sensor Cable)	Electrified Fence
Cameras				
Camera Detection Range (meter)	250m	200m		
Number of Cameras Needed	16	20		
Cost per Camera	$5,000	$1,100		
Total Camera Investment Costs = Cost per camera x number needed	$80,000	$22,000		
Other Equipment				
DVR (1)				
Lights: 80 lights - one every 50 meters -$250/light		$20,000		
Sensor Cable - $50/meter			$200,000	
Aluminum walltop post + 8 insulators: 910 pieces				$30,030
750 mm Stays: 70 pieces				$33,180
Donza Wire Tensioner: 420 pieces				$13,440
Trufix Nail in Anchors 8 x 80 mm Upat: 420 pieces				$3,864
Stainless Steel Wire: 2 mm: 316 grade				$20,790
EMX 6 Sector System with Remote Control and Monitoring				$23,680
Other material: wires, screens, adaptors, ...	$7,000	$7,000		$2,250
Total other equipment	$7,000	$27,000	$200,000	$127,234
Setup				
Total Setup Costs : civil works, concrete, ...	$8,000	$10,000	$5,000	$30,000
Maintenance				
Bulb replacements (IR bulb replacement: 2 x per year)		$100		
Yearly Maintenance Cost per System (all cameras, bulbs, systems, ...)		$8,000		5,000
Total Maintenance Costs over Expected Life		$40,000		$25,000
Energy				
Energy Cost per KWH	$0.06	$0.06	$0.06	$0.06
Power per Camera (Watts)	3 Watt	3 Watt	3 Watt	
Power per Lighting/Illuminator (Watts)		100 Watt		
System Power for fence				50 Watt
Yearly power cost	$25	$2,134	$25	$26
Yearly energy costs per camera/lamp/system x expected life	$126	$10,670	$126	$131
Total Cost of Ownership for 5 years	$95,126	$109,670	$205,151	$182,365

Conclusion

Although all technologies have advantages and disadvantages a small calculation makes it clear that thermal imaging is a very good and a very cost effective solution for protecting a perimeter. Definitely if this perimeter, like in practically all cases, also needs to be protected during the night.

It is shown that although a thermal imaging camera is more expensive than a CCTV camera, less cameras need to be deployed to cover the same area. The civil works that need to be carried out are minimal. In some cases the cameras can even be mounted on existing structures. Furthermore, since thermal imaging cameras produce a clear image in the darkest of nights, no complimentary technologies

like light or infrared illuminators need to be installed. Not only is this limiting the amount of civil works that needs to be carried out but is it also reducing the maintenance cost.

Thermal imaging cameras also generate fewer falls alarms which is a common problem with CCTV cameras combined with Video Motion Detection or Video Content Analysis softwares.

Although thermal imaging cameras are more expensive than CCTV cameras at initial purchase, the case study shows that they are often not only the best, but also the most cost effective solution.